Hunter 12-26-2001

Memorandum

To: Dave Coolidge

CC: Kamrul Choldhurry (LM), Lun Xie (Swales)

From: Jack Hunter

Date: 12/26/2001

Subject: SRA RF Enclosure & Hybrid Temperatures For NOAA-K&L

Ref. 1 "Thermal Analysis of the NOAA-15 SRA, Hunter J., Memo. 7/6/01

Anomalies have occurred on both the NOAA-K and the NOAA-L SAR Antennas and these anomalies are described in TOARS 398 and 402 respectively. Although the NOAA-K anomaly is intermitted and the NOAA-L problem is continuous, both anomalies are thought to be thermal stress/fatigue related. Both anomalies have the same symptoms, which are: the 234.0 Mhz channel on both spacecraft have lost about 25 dB and the 121.5 channel on both S/Cs are operating nominally. The cause of these problems is believed to be a thermal fatigue related and the location of this fatigue failure is thought to be between the output of the 243.0 Mhz hybrid and the RF connector at ESM bulkhead.

Swales has constructed a thermal math model, which represents the SRA. This model includes five nodes representing the RF enclosure, one node representing each of the three hybrids and one node representing each of the four cradle longerons. Since the external cable is attached to the cradle, the cable temperature is assumed to be the same as one of the cradle longerons. A detail description of the model is given in Ref. 1. Also, the nodal arrangement of the RF enclosure and of the cradle is shown in Figure 1. The hybrid, hybrid-mounting surface and external cable temperatures for both spacecrafts were computed using the following orbital parameters:

S/C	NOAA-K	NOAA-L
Altitude (N.M.)	449.7	471.3
Inclination (deg)	98.71	98.78
Cant Angle (deg)	37	22
Solar Array Offset Angle	-45	-35
Time of Year	5/22/01	11/13/01
Sun Angle (deg)	37	58

Orbital temperatures of the hybrids, hybrid mounting surfaces, and external RF cables are given in Figures 2 through 13. Cold and hot temperatures are given for both NOAA-K & L.

Using these temperature histories, the largest temperature difference between the 243.0 Mhz hybrids and their mounting interfaces was 12.5°C. Given the fact that both the RF enclosures and the hybrids are aluminum and assuming that there is an interference fit between the hybrid and its mount, a compression stress as high as 2875 psi could develop in the aluminum hybrid casing.

$$\text{Stress} = E\alpha(\Delta T) = 10\text{x}10^{+6}\text{x}23.1\text{x}10^{-6}(12.5) = 2{,}875 \text{ psi}$$

This stress calculation is very very preliminary. However, in order to obtain a reliable thermal fatigue analysis on the hybrid, connector and external cable, the following tasks should be performed:

Lockheed do

- Obtain a Merrimac hybrid and dissect it.
- Obtain a drawing of a Merrimac Hybrid
- Check the dimensioning & tolerances of the hybrid mounting holes in the RF enclosure for possible interference with the hybrids
- Verify the temperatures given herein
- Compute mechanical and thermal stresses on the 243.0 hybrid, the J1 output connector, and the external cable
- Perform a fatigue analysis on all solder joints in the hybrid, on the J1 connector, and on the external cable.

Figure 1 Nodal Arrangement of the RF Enclosure and Cradle

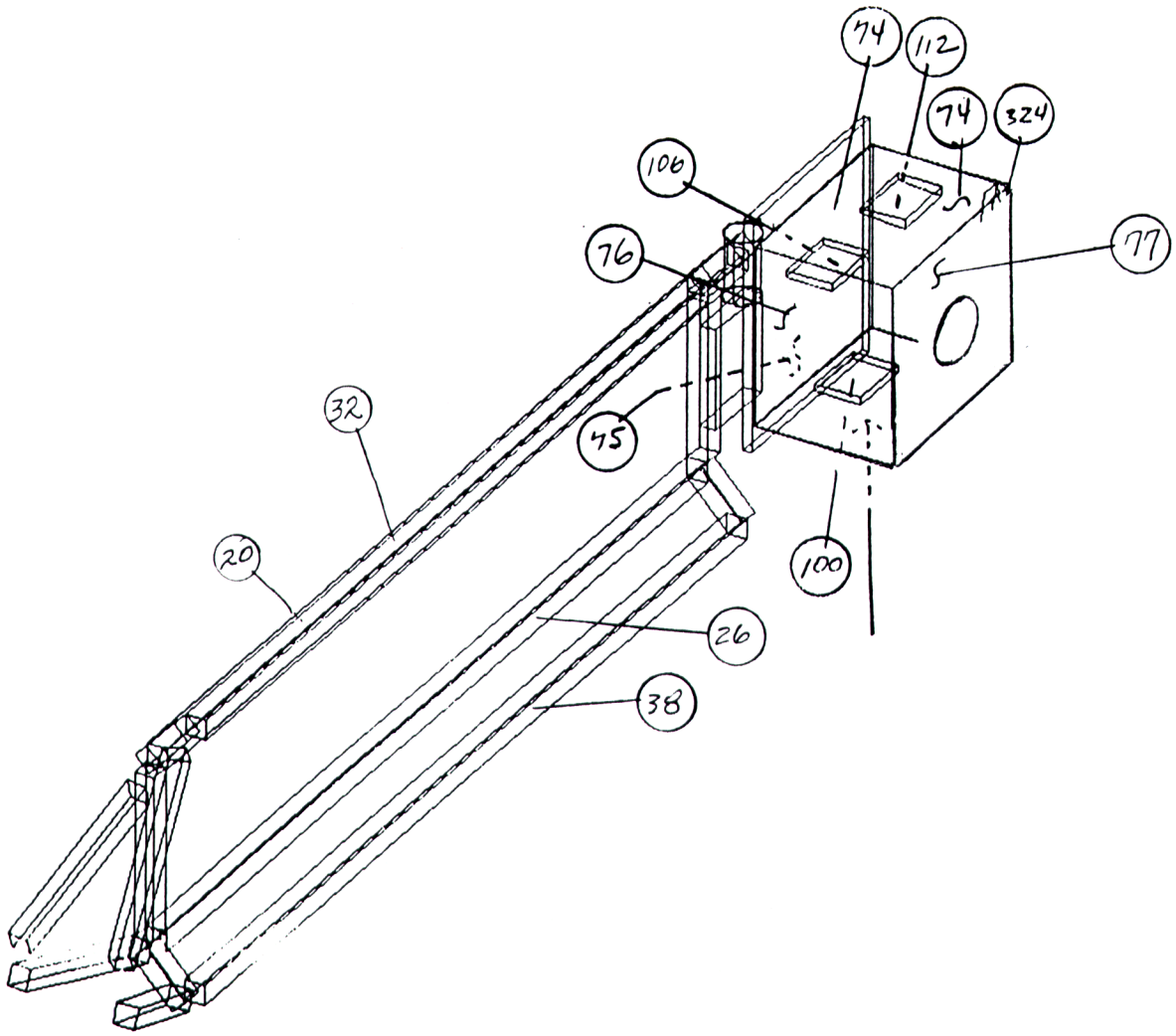

Figure 2 External SRA Cable, NOAA-K, Cold Case

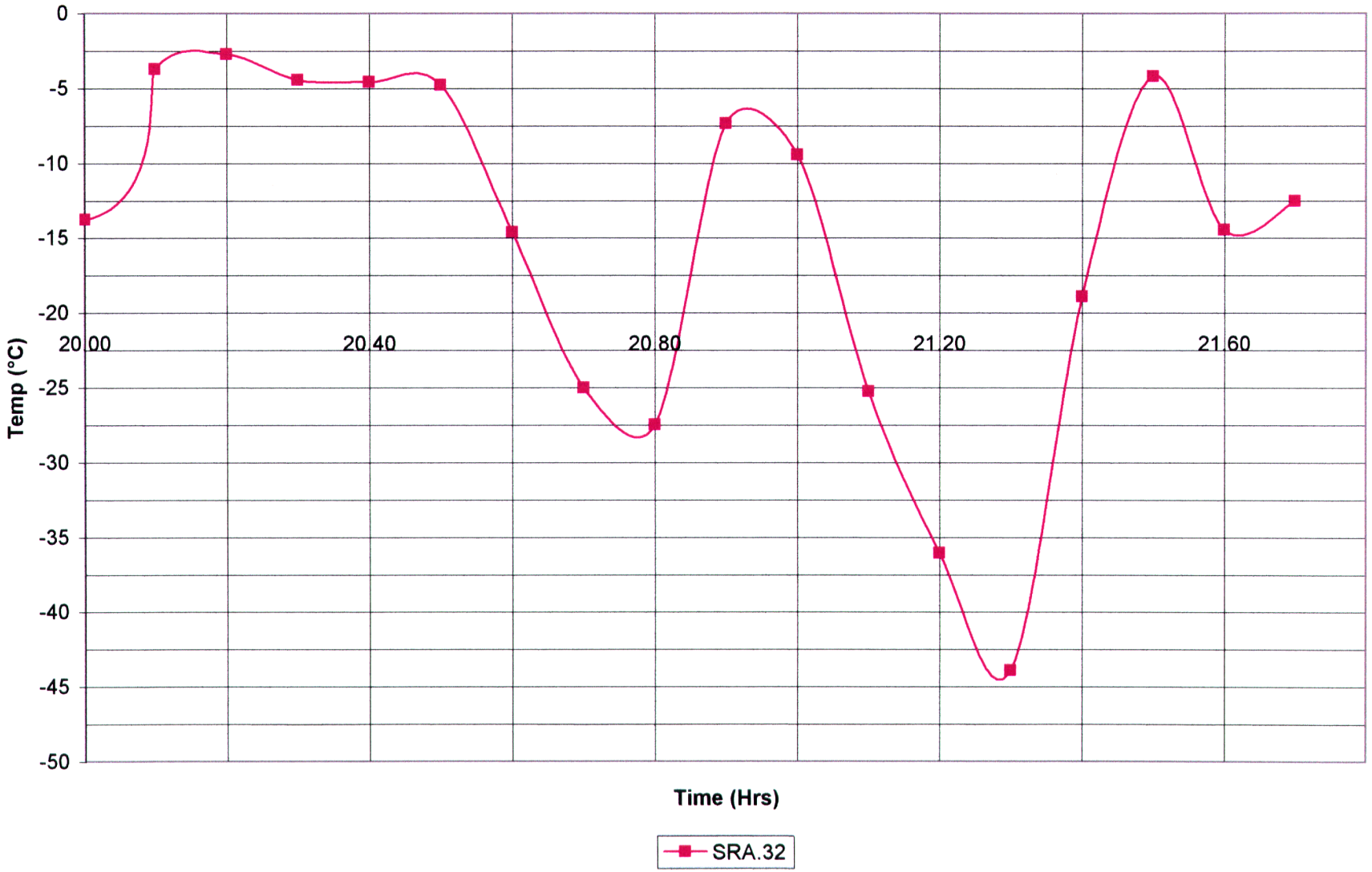

Figure 3 **NOAA-15,SRA Temps., Cold Case, 406 Mhz Hybrid & Mounting Surface**

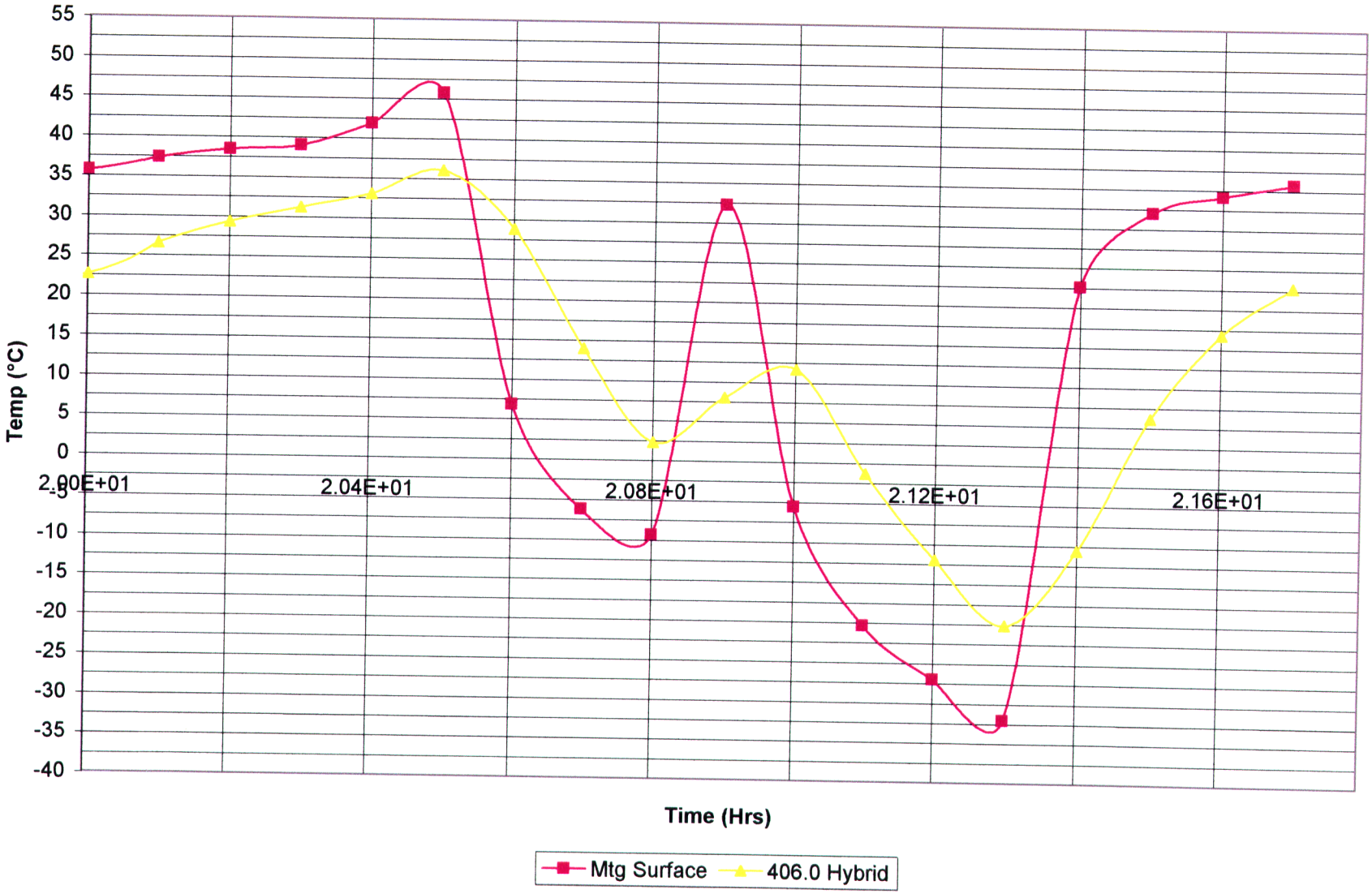

Figure 4 **NOAA-15,SRA Temps., Cold Case, 121.5 ,243.0 Hybrid & Mounting Surface**

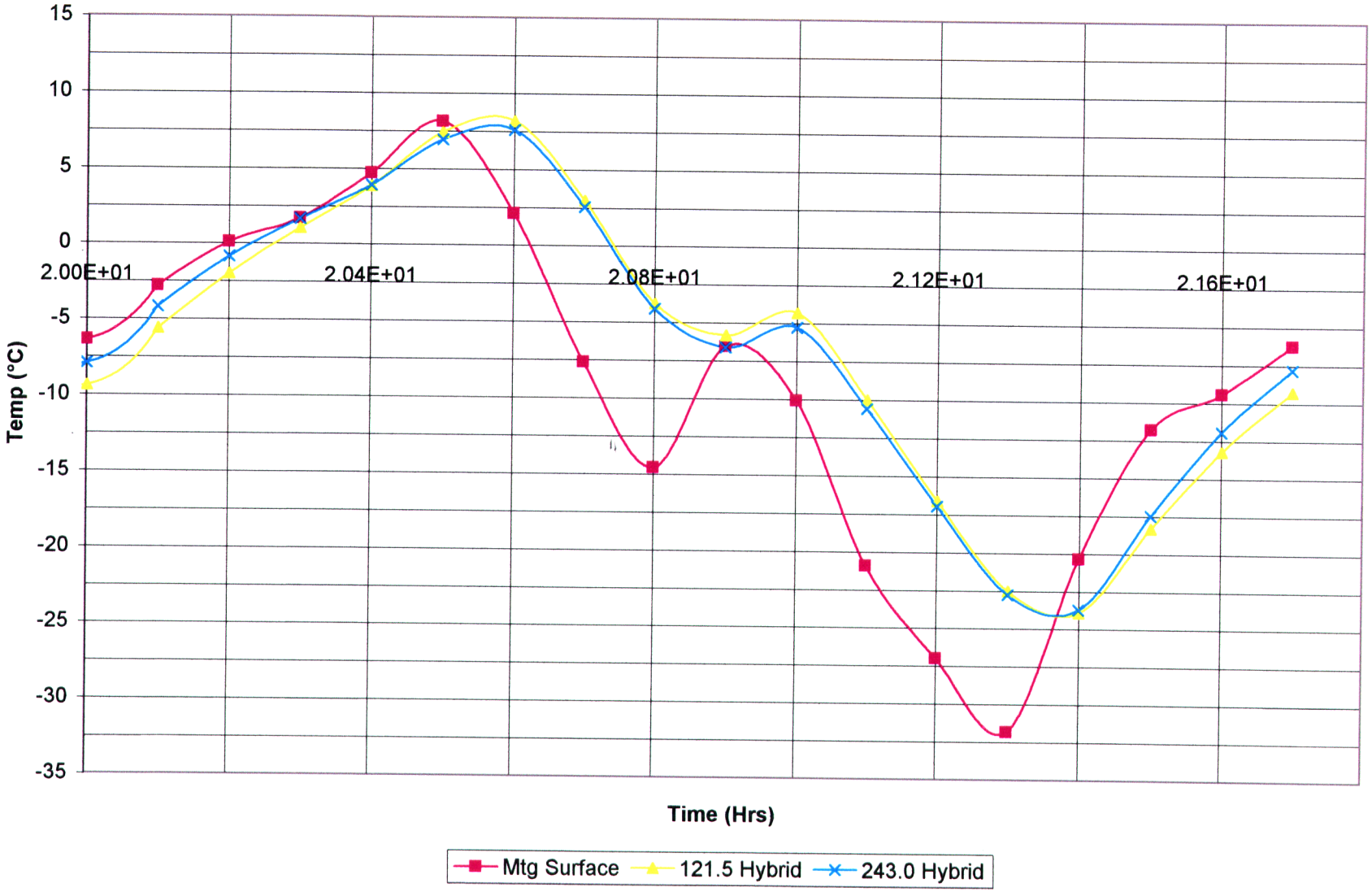

Figure 5 External SRA Cable, NOAA-K, Hot Case

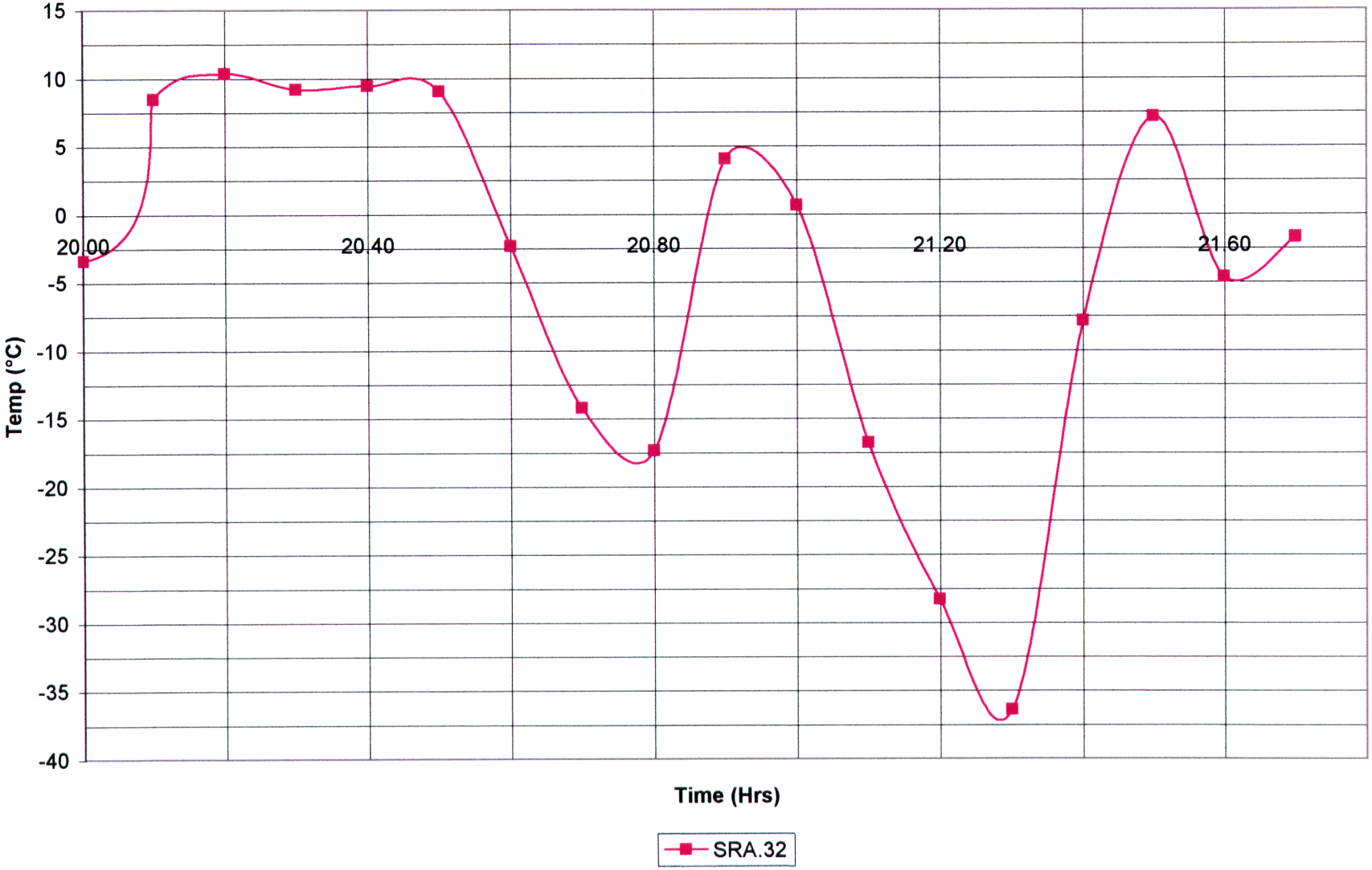

Figure 6 **NOAA-15,SRA Temps., Hot Case, 406.0 Hybrid & Mounting Surface**

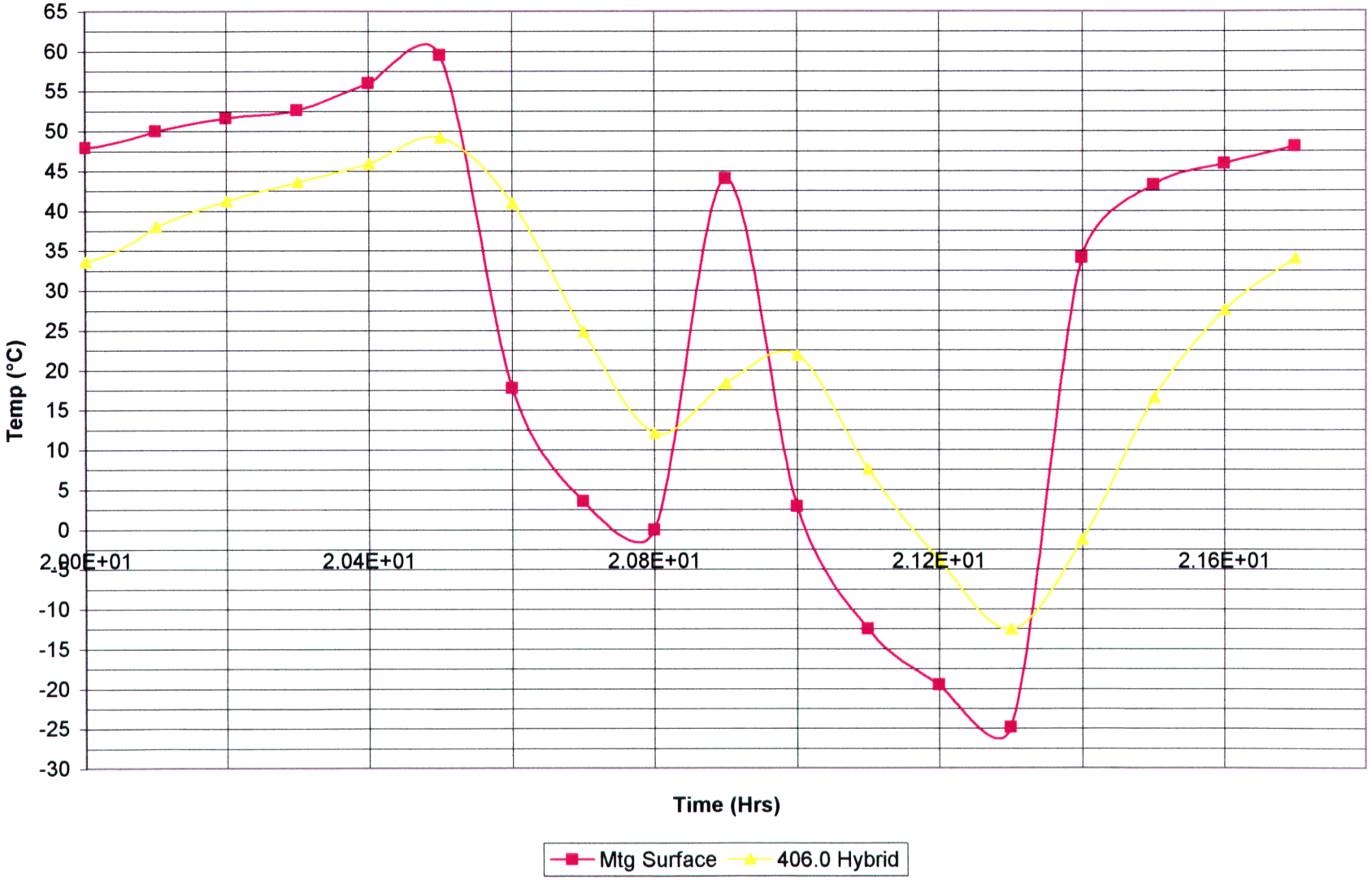

Figure 7 **NOAA-15,SRA Temps., Hot Case, 121.5 ,243.0 Hybrid & Mounting Surface**

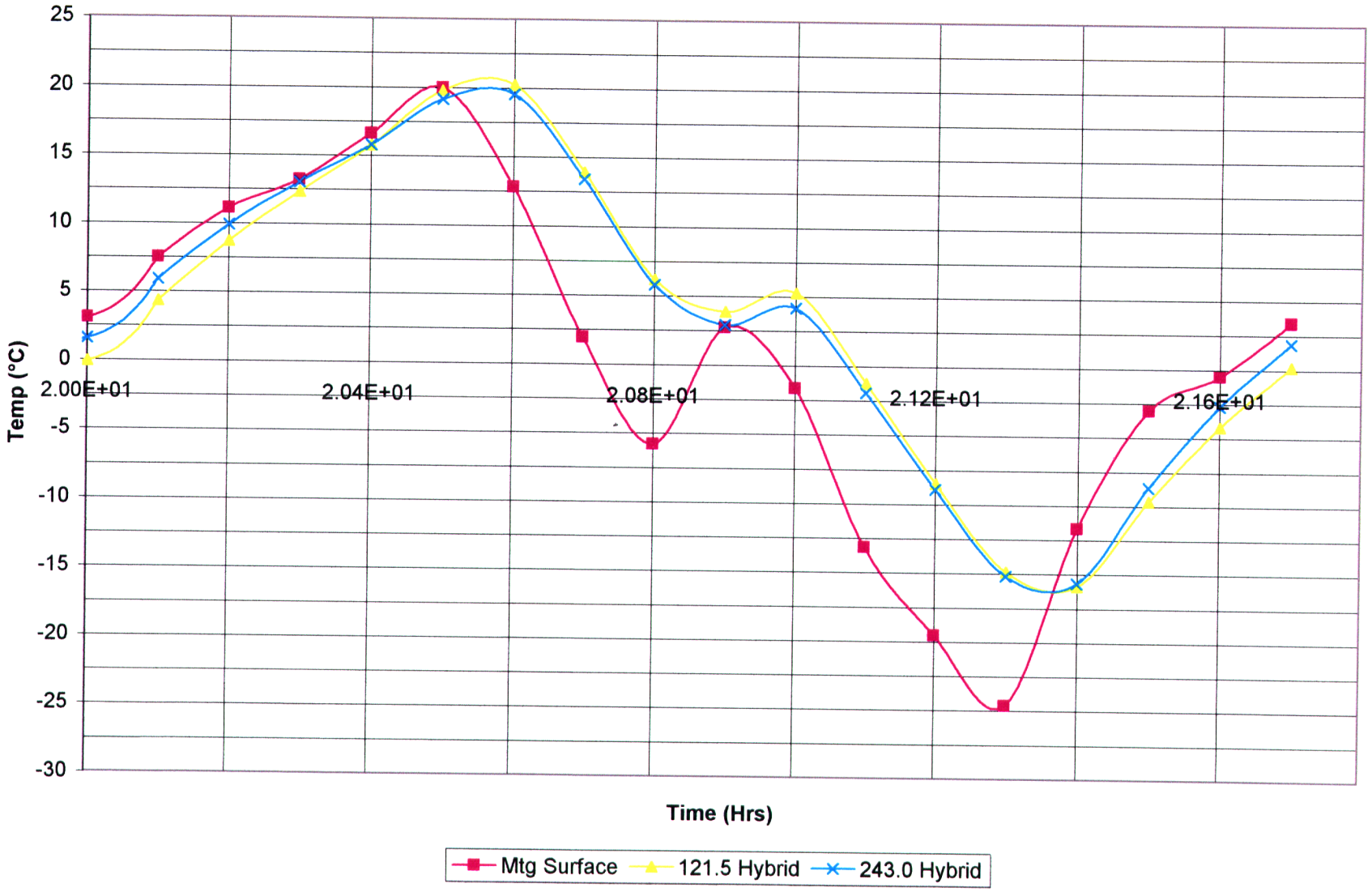

Figure 8 **External SRA Cable, NOAA-L, Cold Case**

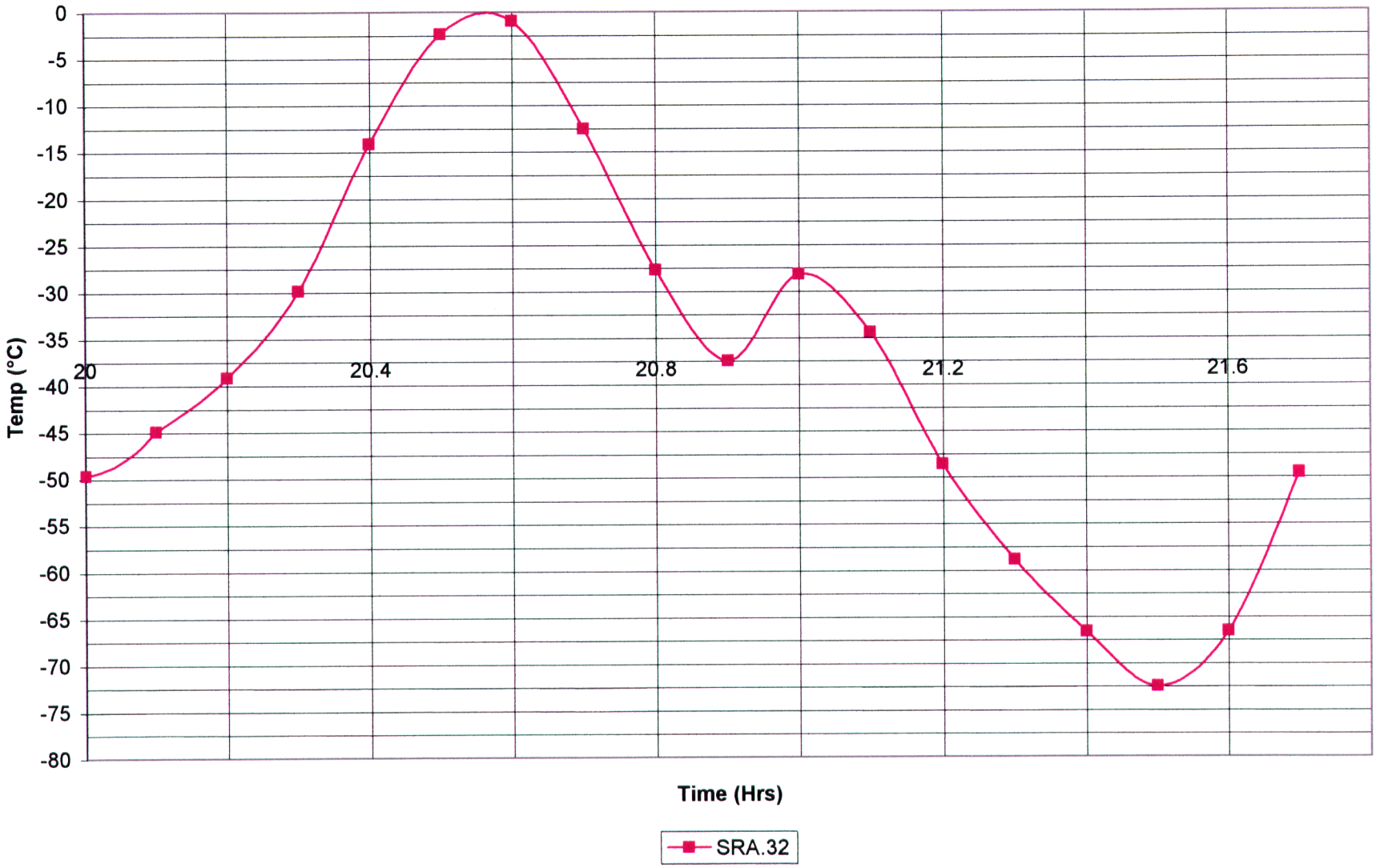

Figure 9 **406.0 Hybrid Temperature Plus its Mounting temperature, NOAA-L, Cold Case**

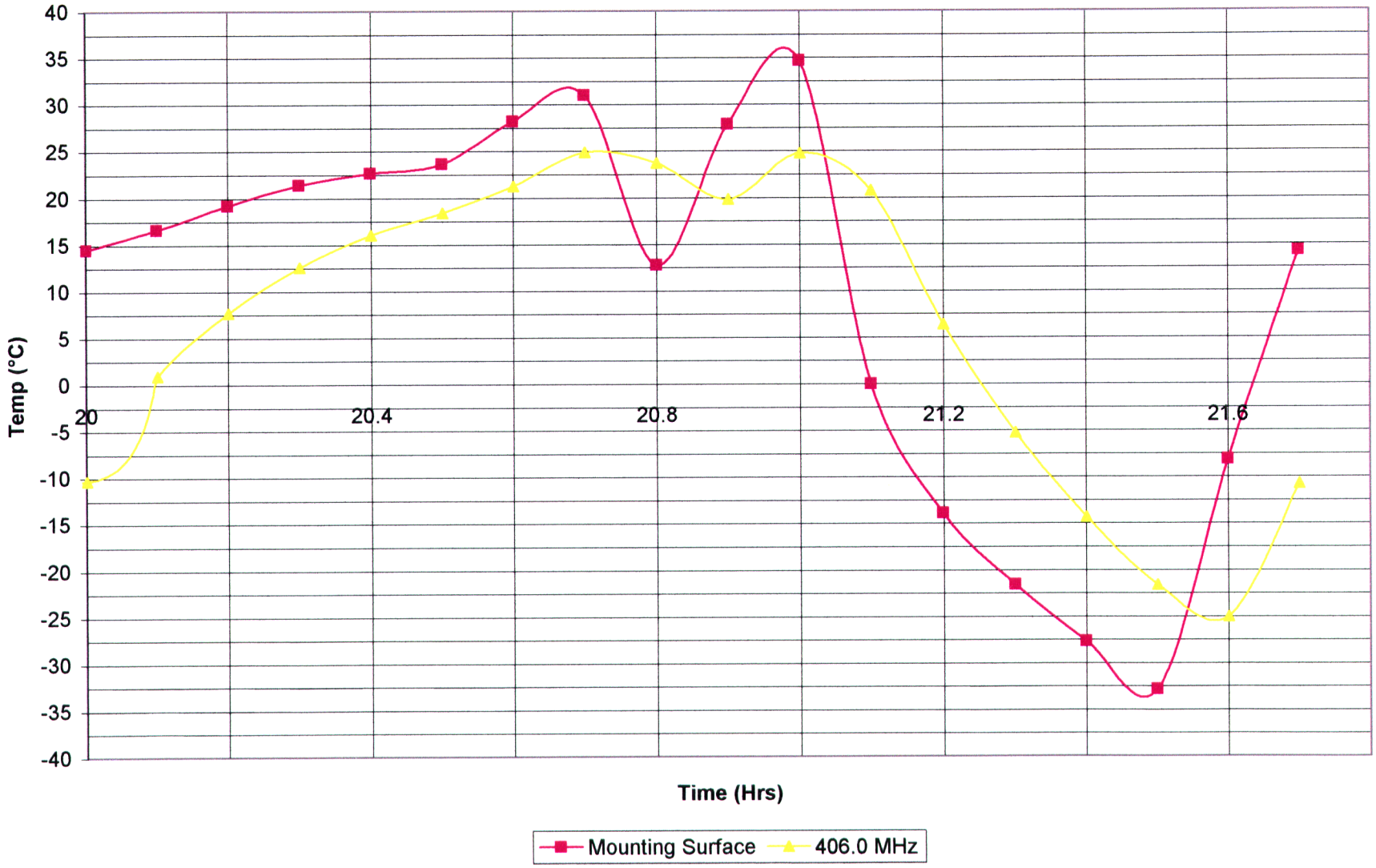

Figure 10 **121.5 & 243.0 MHz Hybrid Temps Plus Their Mounting Temps, NOAA-L, Cold Case**

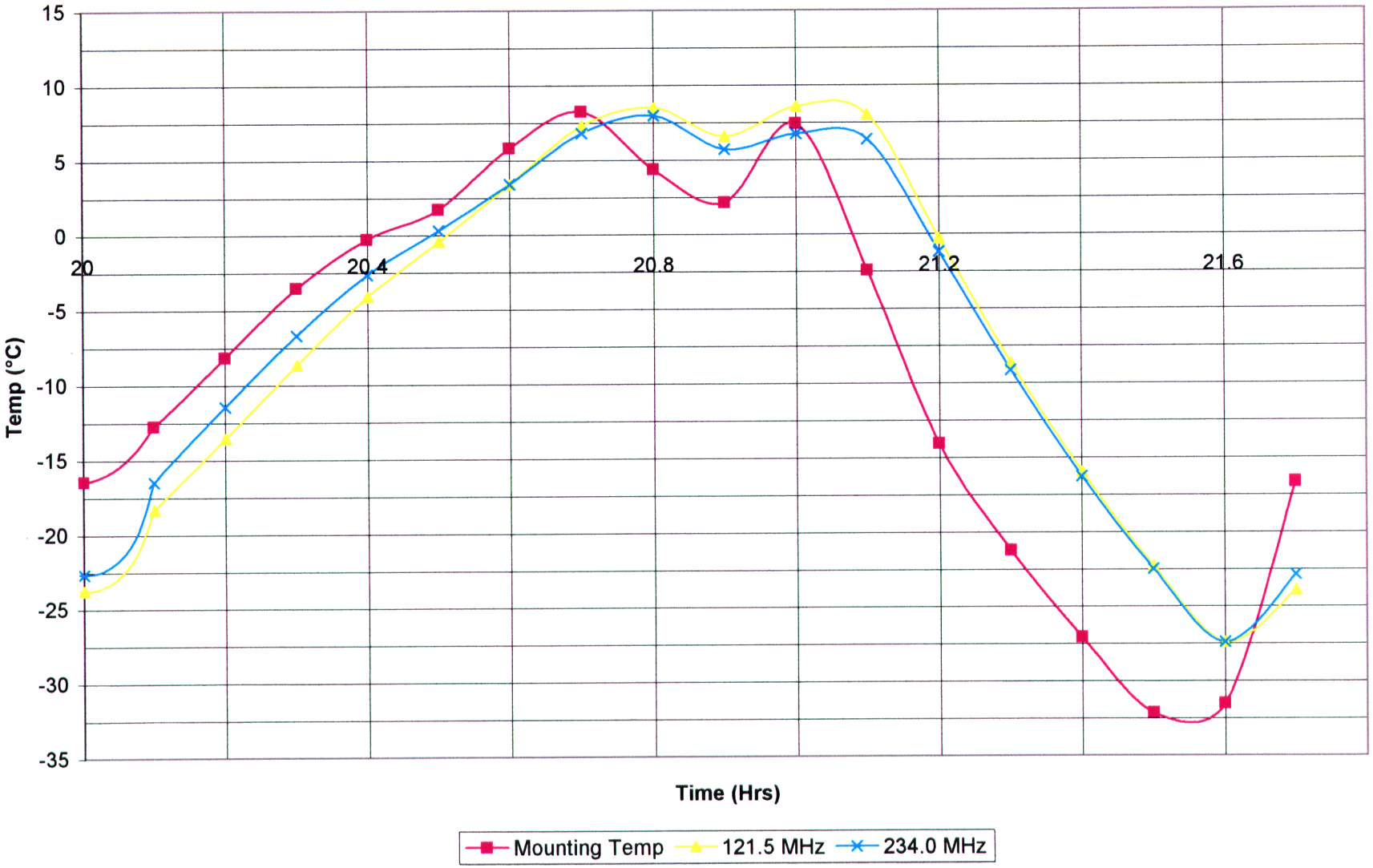

Figure 11 **External SRA Cable, NOAA-L, Hot Case**

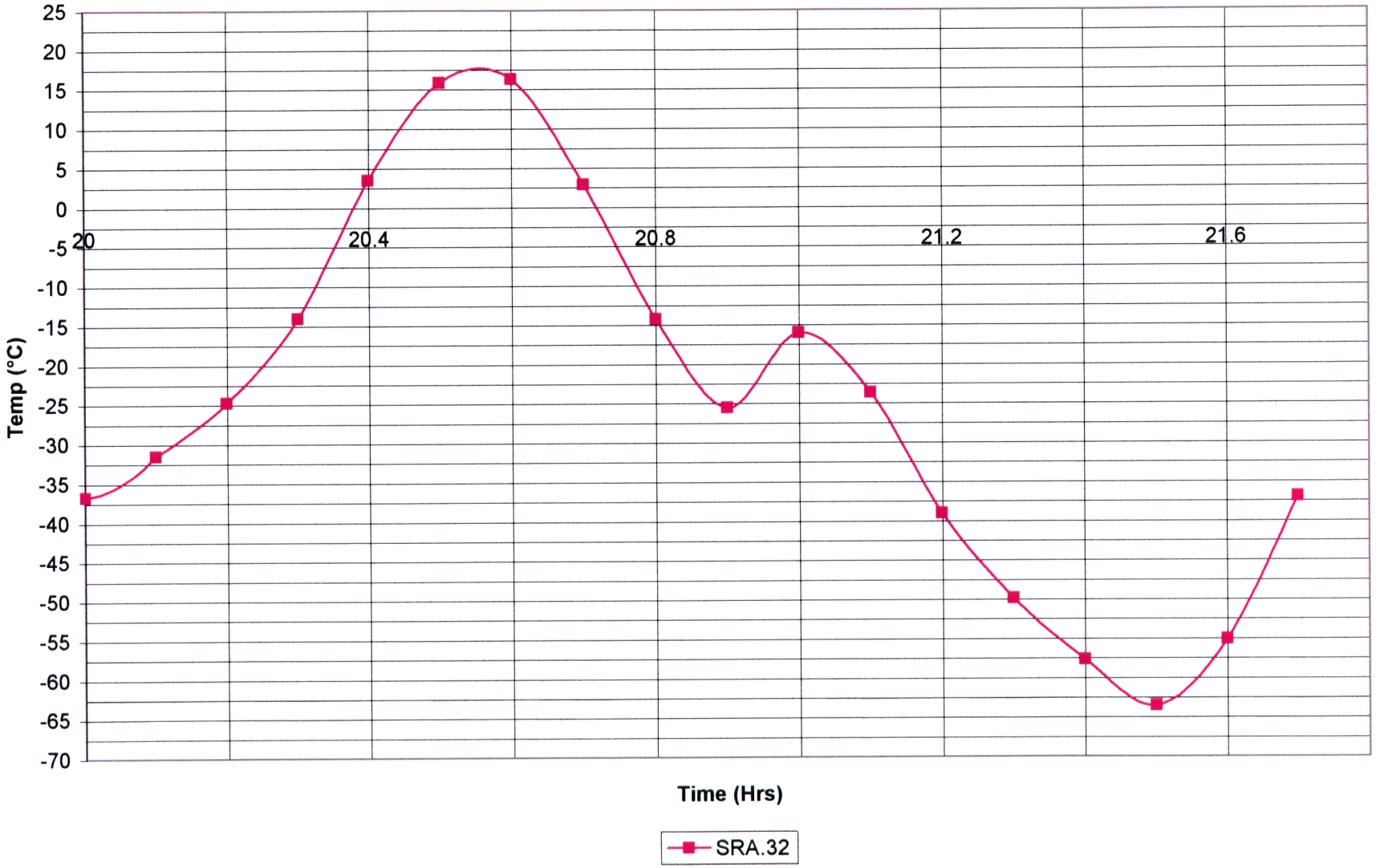

Figure 12 **406.0 Hybrid Temperature Plus Its Mounting Temperature, NOAA-L, Hot Case**

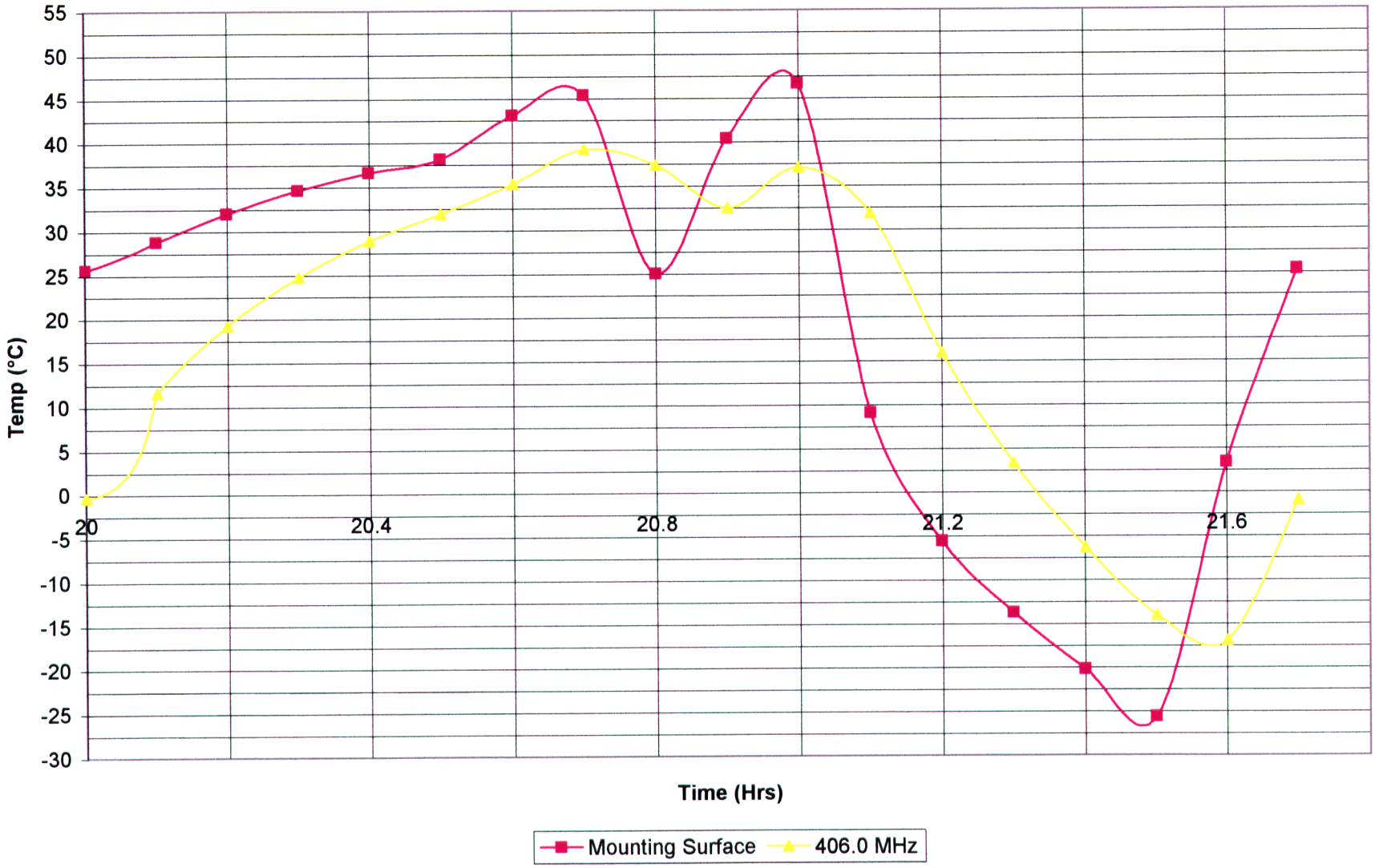

Figure 13 **121.5 & 243.0 MHz Hybrids Temps Plus Their Mounting Temps,NOAA-L, Hot Case**